



Are You Playing in a Toxic Dark Pool?

A Guide to Preventing Information Leakage

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With their promise of liquidity and low-impact trading, dark pools have quickly become a mainstay of buy side trading desks. Industry wide, the number of dark pools has mushroomed to over 40 since 2002 and volume is expected to grow to nearly 1.5 billion shares in 2010, an annual growth rate of 40%*.

Dark pools are as varied in characteristics as they are in number. The individual approaches they take to ownership, pricing, access, constituency, and other factors can raise questions about the quality of their performance. Most traders assume that if orders and crosses are hidden, any information leakage is likewise out of sight. Is information leakage ubiquitous across dark pools? How much leakage is there from pool to pool?

Furthermore, information leakage can lead to a degradation in liquidity quality but how do you know which dark pools are “toxic”? And to what degree? What are the impacts?

This article begins with a classification of dark pool types and discusses various assumptions and issues related to dark pool information leakage and toxicity levels. Specifically, we will cover:

- **Taxonomy of Dark Pools** – First, we present the different types of dark pools operating today as well as their unique and common characteristics.
- **Dark Pool Myths** – Second, we take a critical look at “zero leakage” assumptions as well as the incidence of and factors leading to leakage.
- **The Impact of Information Leakage** – Third, we explore the consequences, including price impact, gaming, and adverse selection and impacts on transaction costs.
- **Spotting Toxic Dark Pools**– Finally, we offer simple rules of thumb/questions you can ask to help assess the quality of a dark pool.

Taxonomy of Dark Pools

Dark pools vary greatly in character and makeup. As a result, potential participants are presented with a broad variety from which to choose but also face the difficult task of evaluating one against another successfully. In comparing dark pools, we can look at their approach to and use of common characteristics including constituency, ownership, price and order discovery, liquidity levels and types, average trade sizes, accessibility, liquidity partnerships, advertisements and IOIs, and more. To understand these characteristics better, we divide them into the following five general categories:

- Public Crossing Networks
- Internalization Pools
- Ping Destinations
- Exchange-Based Pools
- Consortium-Based Pools

This simple categorization is a fairly good way of understanding not only how and why dark pools operate, but provides some context for evaluation and comparison. Although we made attempts to keep these categories mutually exclusive, due to their constant evolution, some dark pools may fall into more than one category over time.

1. Public Crossing Networks

Public crossing networks are the most traditional dark pools. Most were started by agency-only brokerage firms with the single economic purpose of generating commissions. Public crossing networks are also the pools to which most buy side firms are directly connected. POSIT®, POSIT NowSM, BLOCKalertSM, Liquidnet, NYFIX Millennium, Pipeline, and Instinet CBX are the most successful and well known.

One of the most distinguishing properties of public crossing networks is that there is no proprietary flow from the dark pool operator. Second, although it seems like the most straightforward model for a dark pool, it is extremely difficult for agency brokers to start a viable new dark pool. Success of these public crossing networks generally depends on getting unique liquidity based on a unique model. For this reason, there have not been too many new entrants in this space. The public crossing networks such as POSIT, Liquidnet, and Instinet were the first entrants in the dark pool space and, as such, enjoy a large institutional customer base and have avoided commodity pricing.

Public Crossing Networks
<ul style="list-style-type: none"> • ITG's POSIT® • ITG's POSIT NowSM • Instinet CBX • Instinet Match • Liquidnet, H2O • NYFIX Millennium • Pipeline
Advertisement-based: <ul style="list-style-type: none"> • BLOCKalertSM • Liquidnet • Pipeline

Generally speaking, most of the registered ATS dark pools are continuous dark pools in that they cross buy and sell orders as they arrive in the system (typically at midpoint) without displaying those buy and sell interests to anyone. But the agency status of these public crossing networks has made a subset model possible—crossing networks based on advertisements. BLOCKalert, Liquidnet and Pipeline are some of the most popular advertisement-based pools. In these advertisement-based pools an alert goes out to the traders (in most cases, to traders with cross-eligible shares on their blotters) but there can be subtle differences among these pools. Since these are some of the most popular dark pools, we have included a small section called “Understanding Information Flow in Advertisement-Based Pools” explaining the dynamics of these pools a bit more in-depth.

2. Internalization Pools

Internalization pools, the second great wave of pools to appear over the last three years, are designed primarily to internalize the operator's trade flow. Credit Suisse's Crossfinder and Goldman Sachs's Sigma X were the first on the scene and most bulge bracket broker dealers, and others, followed with their own offerings shortly thereafter.

Initially broker-dealers set up these pools to internalize trade flow for cost-saving purposes, but most of them were later opened up to buy side firms directly.

Internalization pools differ from public crossing networks in that they can contain the operator's proprietary flow beyond just the flow from their retail customers and agency flow from their institutional customers. The major incentives to operate an internalization pool can be cost savings (crossing internally rather than sending orders outside), alpha generation (interaction with proprietary flow) and commission generation (offering dark pool liquidity directly to buy side customers). Another major incentive is to be able to market the firm's brokerage services more easily to buy side institutions. By creating a pool that the firm has complete control over, it can provide or restrict access to other sell side firms as it sees fit. This need, more than any other factor, has driven most of the bulge bracket firms to create and grow internal dark pools.

Internalization Pools

- BNY Convergenx
- Credit Suisse Crossfinder
- Citibank Citi Match
- Fidelity CrossStream
- Goldman Sachs Sigma X
- Lehman LCX
- Merrill Lynch MLXN
- Morgan Stanley MSPOOL
- UBS PIN

The success of any internalization pool is greatly dependent on seed liquidity. However, unlike public crossing networks, not all the liquidity has to come from external constituents; it could come from the firm's market-making arm, its proprietary desk, etc.

A current trend among internalization pools is to procure external "liquidity partners" to help supply or take liquidity from these pools. Liquidity partners constitute a special class of participant because they are integrated with the dark pool differently than the pool's regular customers. As such, there is the potential for information asymmetry within these dark pools which we will discuss later in this article.

3. Ping Destinations

Ping destinations are quite different from other dark pools in that they only accept IOC (Immediate or Cancel) orders and unlike other dark pools, their customers' flow solely interacts with the operator's own flow. Ping destinations are generally operated by big hedge funds or electronic market makers. These electronic market makers have quantitative models running in black-boxes that determine whether the pool should accept

or reject the IOC order. Although some ping destinations have tried to approach buy side customers directly, their major direct customers are sell side firms using dark pool aggregators or smart routers to “ping” them—hence, their name. These pools are typically priced extremely competitively – sometimes even cheaper than an exchange or ECN.

The economic incentive for a ping destination could be cost savings (by avoiding routing flow out to the market), spread-making (unlike other pools these dark pools do not always give mid-point execution) or alpha generation (their customers’ flow only interacts with their proprietary flow).

Another major distinction is that ping destinations can discriminate among customers as to who get filled. Such distinctions are usually based on the nature of customer flow, pricing, speed of incoming order, etc.

Ping Destinations
<ul style="list-style-type: none"> • ATD • Citadel • GETCO

4. Exchange-Based Pools

We combine two types of dark pools in this category: dark pools that are actually registered ATSs by exchanges (e.g., ISE Midpoint Match, Nasdaq Cross, and NYSE Matchpoint) and pools of liquidity created as a result of hidden order types supported by ECNs and exchanges. We also refer to the latter as “hidden pools”. (Hidden order types are different from an iceberg or reserve order type in that customers do not need to display even part of an order and thus the quote does not change regardless of the price and size set by the trader.) We combine the explicitly exchange-registered ATS dark pools and hidden pools because they share many similar characteristics.

The pricing of exchange-registered ATS dark pools is similar to other dark pools—priced on a per share basis—whereas the pricing of the hidden order type pools is based on the supplier-taker model, which is typical to exchanges/ECNs. In a supplier-taker model, the customer gets a rebate for supplying liquidity and pays (typically more than the rebate) when taking liquidity. The economic incentive for supporting hidden order types or starting exchange-registered ATS dark pools is to attract more liquidity to the exchange/ECN. The higher the resident liquidity, the more customers will take the liquidity from these ECNs/exchanges, and the more money these ECNs/exchanges will make.

Exchange-Based Pools
Hidden Pools: <ul style="list-style-type: none"> • ARCA • BATS • Nasdaq • DirectEdge
Registered Pools: <ul style="list-style-type: none"> • ISE Midpoint Match + • Nasdaq Cross • NYSE Matchpoint

The most distinguishing characteristic of these hidden pools is that the hidden orders usually interact with regular displayed orders. In other words, the cross does not happen just between the two hidden orders but also between a hidden order and a regular displayed exchange/ECN order. This has implications on information flow, as we will

discuss later. The hidden dark pools within ECNs have been very successful. The statistics on those orders are not published but our research shows that about 15% of their entire volume is traded using these order types within the NBBO spread.

5. Consortium-Based Pools

Unlike other dark pools started by one broker, consortium-based pools are operated by numerous partnering brokers. LEVEL and BIDS are two such ventures. At a high level, these dark pools seem like a hybrid of public crossing networks and internalization pools. They are different from a crossing network in that they are not typically owned by agency-only firms. And unlike internalization pools, consortium-based pools operate as separate organizations and as a result there is more transparency into the business model. For example, consortium pools are typically available to all sell side firms and accessibility is not protected based on each partner's individual interests.

It is quite tricky to understand the owners' economic incentives for starting these dark pools. Citi, Credit Suisse, Fidelity brokerage, Lehman Brothers and Merrill Lynch started LEVEL. Thirteen other broker dealers (most of which are also investors in LEVEL, except Fidelity) started BIDS. In addition to partnering in a consortium, most of these investors also have their own dark pools as a mechanism for internalizing flow. In this situation they have multiple, significant incentives to use their own dark pool rather than the consortium, including cost savings and having a competitive advantage over other firms. Moreover, the consortium partners are generally major competitors with each other outside of the consortium. As a result of these factors, consortium pools work well as "second step" pools—each broker will first try to cross within their own pool and the orders (or parts of the orders) that do not get executed will be sent to the consortium pools. Thus these pools lack the "first step" liquidity available in public crossing networks and internalization pools. The "second step" nature of liquidity in these pools makes them very price driven.

Consortium-Based Pools
<ul style="list-style-type: none">• LEVEL• BIDS

These pools are very similar to the ECNs in that the liquidity in a pool is largely dictated by the pricing. LEVEL, the most successful consortium in terms of volume, is the cheapest pool and became so in very short time. This is no different from the success of BATS ECN, which attracted significant market volume within one month through competitive pricing. Consortium pools are also similar to ECNs in that they serve the sell side firms. Since the business model of these pools is mainly driven by price, there are implications on constituency and information flow, as we will study later in this article.

Figure 1. Characteristics of Major Types of Dark Pools

	Public Crossing Networks	Internalization Pools	Ping Destinations	Exchange-Based Pools	Consortium-Based Pools
Ownership	Agency-only brokerage firms	Generally Bulge Bracket Broker Dealers	Electronic Market Makers/ Hedge Funds	Exchanges	Bulge Bracket Broker Dealer Consortiums
Economic Incentive	Commission	Cost Reduction, Alpha, Commission	Cost Reduction, Alpha	Commission, Generate more taker flow	Commission
Advertising based?	Some, e.g. BLOCKalert, Liquidnet, Pipeline	No	No	No	No except BIDS
Non Advertisement based pools	Some, e.g. POSIT, NYFIX Millennium	Yes	Yes	Yes	Yes
Possible Interaction	Customer Vs Customer only	Customer Vs Customer and Customer Vs Proprietary flow	Customer Vs Proprietary only	Customer Vs Customer only	Customer Vs Customer Investor Vs Investor Customer Vs Investor
*IOIs to invite liquidity from outside Liquidity Partners	Not Likely	Likely	Not Likely	Not Likely	?
Interaction with proprietary flow	Does not apply	Yes	Yes	Does not apply	?
*IOIs to internal prop desk/black boxes	Does not apply	?	Yes- since the black box receives the orders	Does not apply	?
Transparency of business model	High	Low	Low	High	Medium to High
Pricing	Varies from Low to High	Varies from Low to medium	Very Low	Supplier - taker based	Low
Internal Policing	?	?	Likely to be No	Likely to be No	Likely to be No

**will be discussed later in the article*

Effect of Mergers and Acquisitions on Dark Pools

Although these categories are useful to compare dark pools, many individual pools are likely to move from one category to another or be part of multiple categories as the marketplace evolves. For example, Citi recently acquired ATD and NYSE bought a stake in BIDS. What impact these actions will have on the nature of these dark pools is yet to be seen.

Understanding Information Flow in Advertisement-Based Pools

We categorize advertisement-based pools as a subtype under public crossing networks based on their ownership structure, constituents and the owners' economic incentives in opening these pools. However, the unique nature of these pools requires additional insight. Advertisement-based pools are based on alerts that inform the (human) buyer or seller of a potential cross. The receiver of the alert can then submit orders to the pool to match against the order. The receiver of the alert may or may not react to the alerts. The scenario where a trader receives an alert but does not submit an order is known as "fading" and fading has implications on how advertisement-based dark pools should operate:

- 1. Agency-only brokers should operate advertisement-based pools.** These pools attract high block sizes from traders and thus no internal proprietary desks should have access to these pools.
- 2. Advertisement-based pools require sophisticated alert models.** There are huge implications surrounding who gets alerts and how much information each alert contains. There are two models possible: (1) the symmetric model where neither side has committed and both sides receive alerts when the pool detects that there is a potential match (both BLOCKalert and Liquidnet use this model; and (2) the asymmetric model where one side has a committed order and the other side gets an alert. BLOCKalert and Pipeline use this model.

Regardless of which model is used certain policies can help avoid information leakage:

- a) Restrict size for alert receiver.** The pools should place restrictions on the minimum size available to trade to make it worthwhile for a trader to send an alert to another trader. Both Liquidnet and BLOCKalert have these restrictions in place. Pipeline broadcasts the alert to all traders, regardless of whether they have the other side and how much they have available. Pipeline circumvents the problem differently as we explain next.
- b) Limit order information in the alert.** For example, BLOCKalert and Liquidnet do not disclose size information on the order although the receiver can infer that the

order size is at least larger than the minimum size restriction. The amount of inferred order quantity is different between the two systems – in BLOCKalert it is a fixed quantity based on the market cap of the stock (enforced by the ATS) and in Liquidnet it is a percentage of the order as set by the trader in his/her blotter. Another difference between the two systems is that in Liquidnet, traders can negotiate a price and size at which the buyer and seller will cross the trade. In BLOCKalert, price and size can not be negotiated – price is midpoint only and the trader gets to know the traded size only after the cross has taken place. Pipeline, since it broadcasts the alert rather than sending it only to participants with potential match, does not disclose the side information either. Pipeline, like BLOCKalert and Liquidnet, puts minimum size restrictions on submitted orders.

Figure 2.
Comparison of Advertisement-Based Public Crossing Networks

	BLOCKalert	Liquidnet	Pipeline
Who gets the alert ?	Trader with a natural cross	Trader with a natural cross	Indication is broadcast to everyone
What types of firms receive the alert?	Buy side firms only	Buy side firms only	Buy and sell side firms
What is alerted	Stock and side	Stock and side	Stock only
How much size can be inferred?	A fixed size based on market cap of the stock (enforced by ATS)	% of the order size in the receiver's blotter (enforced by the trader)	A fixed size based on market cap of the stock (enforced by ATS)
Price Information	No	Yes but in trader's control	No
Minimum size restrictions?	Strict	Strict	Strict
Fading can be measured	Yes	Yes	No
Pricing?	Premium	Premium	Premium

3. Advertisement-based pools should provide symmetric access to all participants. The nature of these pools implies that each trader should have equal

access—everyone should have access to the same functionalities. As we will see later, that may not be true in some dark pools.

- 4. Advertisement-based pools should measure constituent quality through fading to keep the constituency clean.** Fading is the most important measurement in determining constituent quality. In both the BLOCKalert and Liquidnet models fading can be measured very easily but in the Pipeline model it is difficult to measure because the alert is broadcast.

As you can see, the concept of “advertisement” has many implications for the inner workings of a dark pool, including ownership, constituencies, symmetry of pool access, alert mechanism, minimum size restrictions, and transparency of rules and policing. All of these factors are needed for a successful advertisement-based pool. On the other hand, the concept of advertisement has been taken to far extremes in some of the pools we will discuss later.

Dark Pool Myths

There are two common misconceptions about dark pools. First, the majority of traders subscribe to the theory that dark pools are truly dark. Second, traders believe that dark pool trading does not impact stock prices. While the majority of this paper deals with information leakage, we feel it is important to also discuss price impact.

MYTH #1: DARK POOLS DO NOT LEAK RESIDUAL ORDER INFORMATION.

The most important pieces of information about your orders are side, size, and the time horizon in which you need to trade your order. If you slice and dice your orders in the displayed market, you reveal the order side and size, thereby affecting supply/demand and causing impact.

Theoretically, a dark pool does not make order information available to the marketplace until after a trade occurs. An execution, however, might produce some market signals. First, the print hits the tape letting others know the dark pool may still have some liquidity in the same name. Most often these are third-market prints, so traders may not be able to tell in which particular dark pool the trade occurred. Second, the trader on the other side of the completed trade knows where it took place and realizes there could potentially be more liquidity on the opposite side of his trade. Last, most firms advertise their completed crosses with services such as Autex and Bloomberg; these advertisements include details on where the cross occurred.

Generally speaking, this kind of information should be harmless. Since residual order size isn't actually revealed, the reasoning goes, your order does not produce buying or selling pressure (demand/supply imbalance) and hence, there is no price impact.

Unfortunately, there is more going on than meets the eye. Dark pools leak information primarily through the practices of fishing and information-sharing.

Information Leakage Example 1: "Fishing"

"Gamers" practice "fishing" to deduce residual order size information in dark pools. The term "gamer" represents traders who try to manipulate orders in dark pools for their own benefit. "Fishing" is used to describe a specific action whereby the gamer sends a series of small orders to a dark pool to detect if there is a large order sitting in that pool. Theoretically, getting fills on small orders is not necessarily an indication of residual liquidity. Yet this assumption falls short because dark pools represent institutional liquidity and institutional orders tend to be large (generally thousands of shares). As a result, if a gamer gets a few fills from a pool, he can generally assume that there is going to be more behind it. Once he locates those orders, he can manipulate the price in his favor in various ways. These manipulation techniques are called "gaming" and we discuss some of these techniques in great detail in the section "The Impact of Information Leakage".

Alternatively, if the trader has a smaller-than-typical institutional order in that dark pool, he can stay out of the market and wait for it to move in his favor. *(We further explore both of these phenomena later in the article.)*

Information Leakage Example 2: Information Asymmetry

Most dark pools do not advertise their flow, with the exception of advertisement-based public crossing networks discussed in the taxonomy section. Most advertisement based pools make trading safe by various policing controls, by restricting access to certain types of customers and by making the entire IOI process completely transparent to its customers. Yet there are pools that do not appear as advertisement based but do use IOIs. The information flow in these pools could be extremely asymmetric. By asymmetric we mean an instance where a trader sends an order to a dark pool and the entire order information (side, size) is made known to another trader or a black box on the other side. The recipient of the information has the opportunity to trade against the order. The information recipient may vary depending on the business model of the dark pool. Some examples of information asymmetry and recipients include:

a) Information asymmetry in ping destinations

As mentioned previously, when a trader sends IOC orders to ping destinations, the market maker operating the ping pool (generally a black box rather than a human trader) is on the other side. In this scenario, all information about the order is

known to the black box and the black box can accept or reject the order. This is a great example of information asymmetry. Typically, ping destinations are accessed by smart routers or dark pool aggregators. Smart routers are offered by broker-dealers and designed to electronically probe the marketplace to locate liquidity. The practice of smart routers sending orders to these destinations can be justified because the orders were destined for displayed markets anyway and are typically very small.

However information may leak if ping destinations are not used carefully, especially for larger orders from dark pool aggregators. Many dark pool aggregators fail to mention their use of ping destinations. Their customers are typically unaware of such use not only due to the aggregator's non-disclosure, but also because their orders are not in the displayed market and so have no way to detect where their orders are getting placed.

b) Information asymmetry in internalization pools

Broker-dealers operating internalized pools have several incentives to share order information with their own proprietary trading desks. First, there is potential profit to be gained. Second, just to be competitive with other broker-dealers, they have huge pressure to build liquidity in their dark pools. If the broker-dealer shares information about resident orders in its internalized pool with its proprietary desks or its own black boxes (by IOI or other means) there is information asymmetry and hence information leakage.

c) Information asymmetry with liquidity partners

Many broker-dealers partner with other firms that have a good amount of flow and invite them to send orders to their dark pools. They provide these firms access with special pricing or other incentives in an effort to build liquidity. As such, these firms are sometimes called "liquidity partners". Generally, liquidity partners send only IOC orders to these dark pools.

There are two types of information flow possible with liquidity partners – 1) the liquidity partner sends orders to the dark pool without the knowledge of other orders already placed, and 2) the broker-dealer sends IOIs to its liquidity partners to attract their liquidity and the liquidity partner has the option to send orders or not. The latter model has information asymmetry. Most brokers do not disclose the names of the liquidity partners and most do not disclose the mechanism used to interact with the liquidity partners. The operators of ping destinations are often liquidity partners in the dark pools as well.

MYTH #2: DARK POOL PRICING IS DERIVED FROM THE DISPLAYED MARKET; THEREFORE, DARK POOL TRADING DOES NOT IMPACT PRICE.

Generally speaking, the execution prices in dark pools are derived from the NBBO in the open market. Most dark pools use midpoint pricing as the execution price for buyer and seller, with some exceptions (customers of some of the ping destinations described above pay the entire spread). Regardless of where in the spread the execution happens, traders believe that since their orders have had no effect in determining the NBBO, they have had no impact on price. In contrast, a trader sending the same order to the open market seeking a midpoint execution would risk moving the entire spread up or down by a half-spread, unless they send an order as a hidden order to these ECNs. Secondly, traders believe that price discovery is made based on a buy/sell imbalance in the open market (exchanges/ECNs). Thus, the imbalance created by their orders in dark pools should not impact stock prices.

Unfortunately, there are problems with these assumptions.

First Problem with Myth #2: Exchange-Based Pools May Support Prices.

Both hidden pools (created by means of hidden order types in exchanges and ECNs) and pools registered as ATs by exchanges interact with the regular displayed flow that is sent to the exchange or ECN. Interaction with the displayed flow can cause these pools to support the stock in the direction of the dark order. This phenomenon can be explained with the following example. Assume a stock has a bid of 10.00 and an offer of 10.10 and there is a hidden buy order at 10.05. If a seller sends a marketable order at 10.00, it will execute at 10.05 and the best bid will remain 10.00. Had the hidden buy order not been there, then the best bid would have been below 10.00. In other words, in this case the hidden buy order supported the market. Had the same hidden order at 10.05 been in a traditional dark pool that is not integrated with ECNs/Exchanges, this order would not have supported the bid and a new bid would again have been below 10.00. Obviously, in this process the buyer got a midpoint execution, which she may have desired. But if she uses these dark pools/hidden order types to park large orders the stock price will never move down (for buy orders). On the other hand, a dark pool not integrated with ECNs and exchanges will not support the price of the stocks. Hidden order types and exchange-supported dark pools can be great liquidity sources for price improvement as long as they are used intelligently and not used like a “regular” dark pool.

Second Problem with Myth #2: Dark Pools With High Frequency Smart Router Flow May Support Prices.

Most of the dark pools created in recent years have used multiple measures to build volume including ultra-low pricing for sell side firms and opening themselves up to the streaming flow from broker-dealer smart routers. However, the more accessible a dark

pool is to smart router or market flow, the more it supports stock prices (it virtually becomes a pool within the displayed marketplace).

The majority of dark pools interact with smart router flow, at minimum, because most dark pool operators allow their own marketable flow to interact with their own dark pool. For the customer, it all comes down to how much marketable flow washes through the pool and what portion of the volume is represented by the smart routers and marketable flow. It may be very difficult to get answers to these questions so it is important to look first at the economics of the dark pool's pricing. If the pricing is cheap, smart routers are more likely to access that pool. If the pricing is more than a regular exchange or ECN, smart routers are less likely to play in that pool. Second, look at the pool's average execution size; the smaller the average execution size, the more likely it represents mostly marketable/smart router flow.

The Impact of Information Leakage

Now that we have discovered some of the ways that information leakage may occur, let us examine how information leakage affects your order execution. Generally speaking, these effects fall into three categories:

- **Price Impact.** Price impact occurs when the stock price moves in opposition to your order (e.g., the price increases for a buy order) as a result of information leakage.
- **Gaming.** Gaming takes place when traders use information about your order to affect your execution and thereby manipulate prices.
- **Adverse Selection.** Adverse selection is when your execution is conditioned on whether the stock price moves in your favor (e.g., your buy order gets executed if the stock moves downward later, but not if it moves up).

Information Leakage Can Impact the Price of Your Order.

The dynamic of price impact in dark pools is generally the same as in the displayed market. In the displayed market, traders expect that orders and executions will increase buying or selling pressure on the stock, thus causing the price to move adversely. Traders believe this is unlikely to happen in dark pools since the orders are invisible. But as previously described, there are multiple ways information can leak in dark pools, and the more this happens, the more dark pool orders will be affected by price impact, just as they would be in the displayed market.

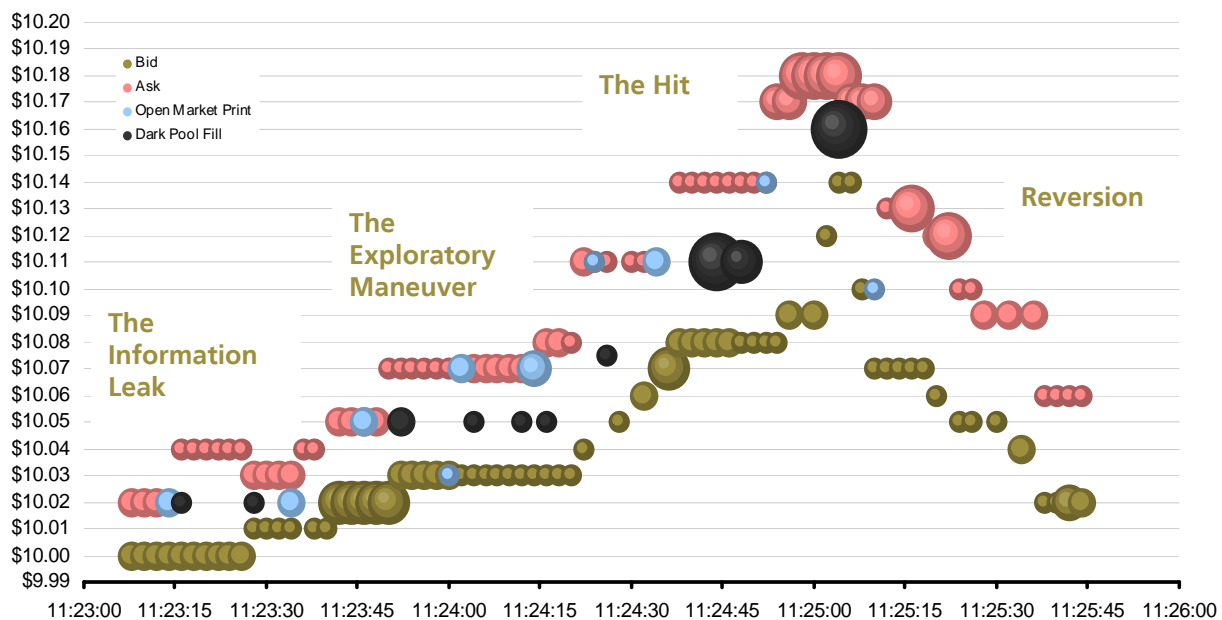
Information Leakage Can Result in Gaming of Your Order.

Savvy traders can use information about your order to manipulate prices in their favor. Some of the most common gaming scenarios include:

- **Gaming by manipulating the stock price.** This scenario is explained with the following sequence of actions as well as in Figure 3.

Figure 3. Gaming with Fishing

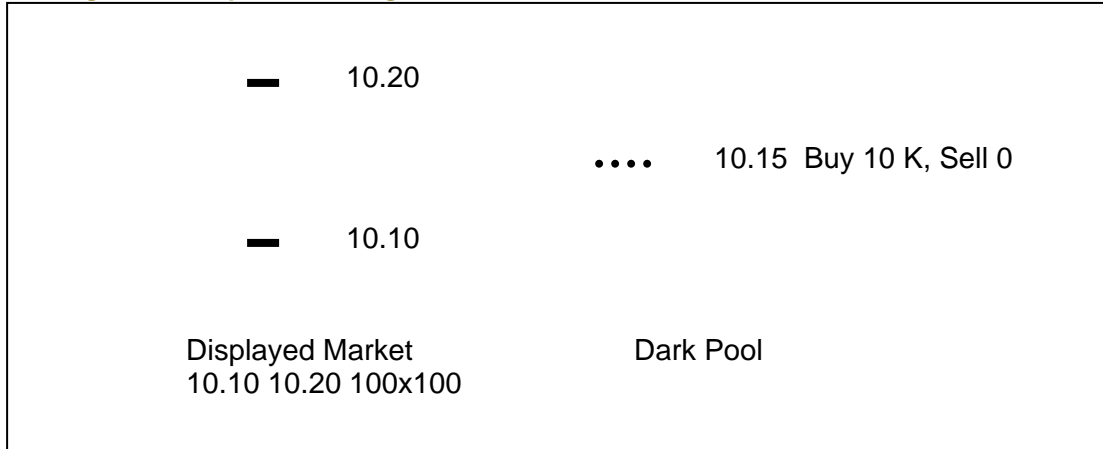
How gaming happens: 1) **The Information Leak (Fishing)**- By selling a few small lots, a gamer determines that a passive buyer has placed a standing order in a stock 2) **The Exploratory Maneuver** - The gamer buys the stock rapidly in the displayed market and succeeds in moving the stock up. 3) **The Hit** - After moving the stock, the gamer sends a large sell order to the dark pool and sells at substantially higher prices than the price he started buying at in the displayed market. 4) **The Reversion** - In less than two minutes it is all over. Prices revert as the gamer stops supporting the market.



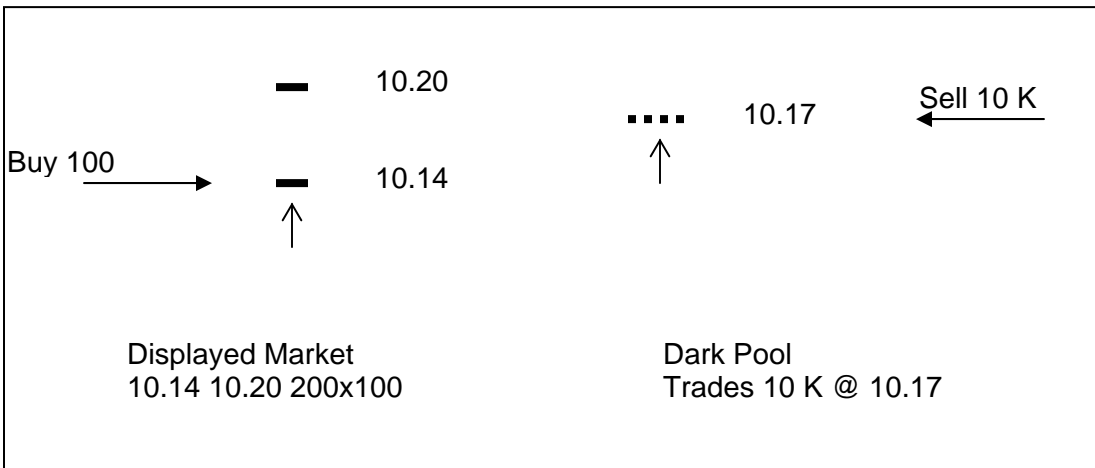
- **Gaming by manipulating the midpoint.** Most dark pools execute more than 90% of trades at the midpoint, since it is derived from the NBBO. Once there is information leakage from the dark pool, traders can manipulate quotes in their own favor. For example, if a stock's NBBO quote is 10.10 x 10.20 and you have a buy order of 100,000 shares, a seller can submit a sell order of 100 shares to "fish" for buy orders in that stock. Once a buy order is discovered, the seller can then send a buy order to the open market @ 10.14 to manipulate the midpoint, following it with a sell order that is executed @ 10.17 rather than 10.15, which would have been the execution

price without the manipulation. The trader will then likely withdraw his buy order from the displayed market, bringing the quote back to 10.10 x 10.20. (See Figure 4)

Figure 4. Midpoint Gaming



Buyer in Dark Pool eligible to execute at 10.15



Sender manipulates the midpoint, buyer executes at 10.17

- **Gaming by market making inside dark pools.** Market makers traditionally tried to capture the spreads by layering the books of ECNs and exchanges electronically. In the displayed market it is more difficult to make markets because displayed orders help competing market makers detect their strategies.

Dark pools, on the other hand, can be a perfect place for market makers to enter or exit a position. When entering a position, they do not need information on other orders in the pool since they can blindly send passive limit orders to these dark pools,

knowing that the orders will execute when there are market swings. To exit a position, however, market makers need some information about other orders; they can obtain this information via fishing or other IOI mechanisms established in dark pools, as described above. The effects on dark pool customers are difficult to quantify in terms of profit and loss, but it is generally safe to say that this is not the kind of flow interaction dark pool customers desire. The dark pool is no longer a level playing field and market makers benefit from it more than the traditional dark pool customers.

Information Leakage Can Result in Adverse Selection.

When a trade execution is followed by a stock price move in the trader's favor (e.g., price drops for a buy order), traders call that phenomenon adverse selection. For example, if a trader puts a buy order representing 2% of average daily volume (ADV) in a dark pool and another trader puts in a sell order equivalent to 30% of ADV, the buy order will be completely executed. The seller will likely take the residual of his 30% ADV sell order out to the displayed market, thus pushing the stock price down. In this example, the buy order was adversely selected.

- **Systematic vs. non-systematic adverse selection.** Obviously this phenomenon will occur in dark pools regardless of information leakage. In a pool with large institutional block orders, there will almost always be one side that is larger than the other. Moreover, the smaller side will always feel disadvantaged in the transaction. Unfortunately, a trader has no way to know going in whether his order is smaller or larger than the other side. The good news is that if adverse selection occurs *naturally*, with no information leakage, it will remain "non-systematic," occurring sometimes but not others. Over time, in theory, it all evens out. In addition, the traders will benefit from not having to pay market makers and specialists the spread and the temporary impact premium that would be due if the order were executed in the displayed market.

If there is information leakage in the dark pool, however, then the problem of adverse selection might be more systematic. For example, if an internal prop desk or a market maker is getting IOIs from a dark pool or otherwise deriving order information from it, they may only buy when the stock is likely to go up (based on the information) or sell when the stock is likely to go down.

There is one more case in which adverse selection can be systematic, even in the absence of information leakage. This can occur when one side is significantly more likely to accurately predict the stock's direction than the other side. For example, an asset management firm with a fund aimed at very long-term alpha is trading in a dark pool against prop desks or quant funds with very good short-term alpha models, the institutions might be adversely affected in a systematic way.

To summarize, non-systematic adverse selection in dark pools, over the long term, does not hurt traders in dark pools. Systematic adverse selection, on the other hand can hurt a trader’s P&L over the long term and occurs either as a result of information leakage or as a result of a heavy concentration of dark pool participants with good short-term alpha.

Figure 5. Dark Pool Customer Types

Every dark pool, regardless of structure, matches two orders—Side A and Side B. If you are Side A, the other side of your order could be any of the following customer types:

Type	Description	Issues	Situation
Customer without Information	An institutional buy side firm with long- term alpha, retail investors	None	Excellent
Customer with Information	An institutional buy side firm with short- term alpha, market makers etc	Systematic adverse selection	Not good
Gamer	A gamer strives to find ways to get information about your order, not through direct information leakage but through derived information leakage (fishing).	Gaming	Bad
Dark Pool	The other side of your order in a dark pool could really be the dark pool vendor itself. You are entrusting your order information to the vendor who could use that information however he or she wants. The other side could be:	Impact, gaming, systematic adverse selection	
	<ul style="list-style-type: none"> • Dark pool itself, e.g. “Ping” destinations 	A bad scenario but at least you know about it.	Bad
	<ul style="list-style-type: none"> • Dark Pool’s Prop Desk (if receives IOI) 	The dark pool might leak the info of your orders to the prop desk by not having strict controls in place.	Really Bad
	<ul style="list-style-type: none"> • Undisclosed Liquidity Partners 	The dark pool leaks to another dark pool or prop desk or market maker by sending an IOI but without telling you.	Worst

Spotting Toxic Dark Pools

Given that so many factors affect the quality of dark pools and there is so little information available about them, it can be a daunting task to assess the toxicity of a dark pool. From a

practical perspective, traders can ask the following questions to assess dark pool quality; these questions also serve as a summary of key takeaways from this article.

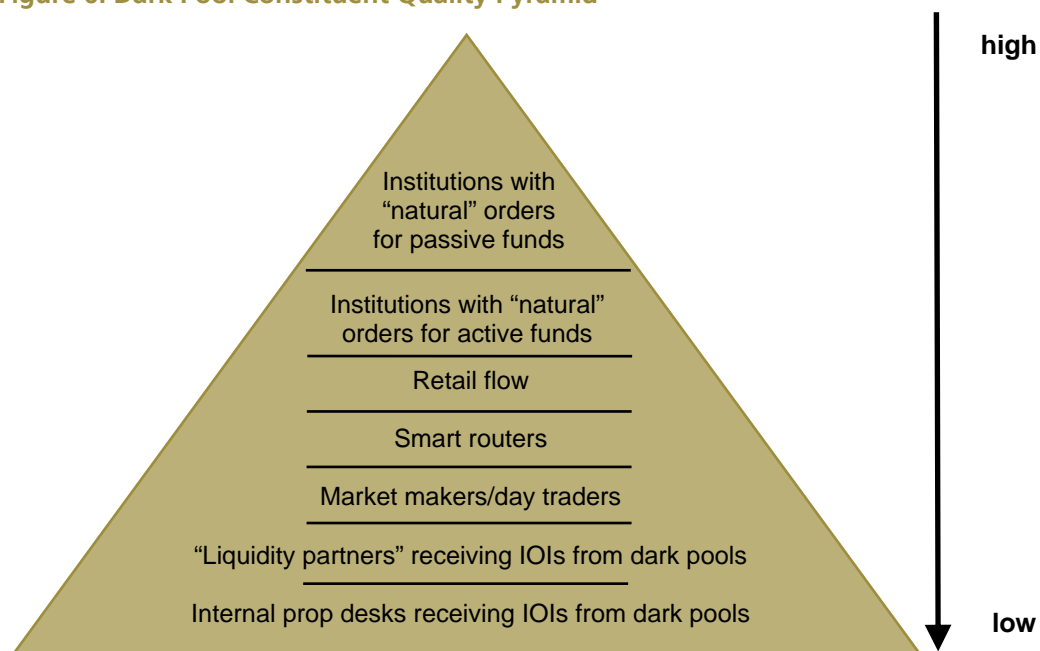
#1 Which dark pools does a dark pool aggregator/algorithm/program desk use and how?

If there is one thing we can emphasize, it is that all dark pools are different. Yet there is massive push by broker dealers selling dark pool aggregators and algorithms to ignore that fact and shift the focus on the fill rate. Some new dark pool aggregators do not disclose the names of the pools they access, citing their non-disclosure agreements. Hopefully this article provides a good framework for understanding the dynamics of different dark pools and the resulting effects on a pool's executions. Traders should try to get as much transparency as they can; once they know which pools are used by an aggregator or algorithm they should demand to know how the fills are distributed. Broker-dealers may have fewer incentives to use their competitors' pools and higher incentives to use low-priced pools.

#2 Who are the constituents?

A dark pool's quality directly reflects that of the players in it. Information leakage is less likely to occur where constituents are less likely to benefit, therefore institutions with "natural" liquidity sit at the top of the quality pyramid. On the other hand, day traders, short-term quant funds, and market makers will find ways to build signals even in a dark pool run with strict rules. So if you can, it is worth finding out about the types and concentration of constituents in each dark pool.

Figure 6. Dark Pool Constituent Quality Pyramid



#3 What is the average trade size?

This is a matter of deduction, since the smaller the average trade size, the more likely it is that players in the pool are market makers, smart routers, or liquidity partners. It is also true that every partial fill of an order potentially leaks some information to the other trader by means of fishing or other liquidity detection techniques. So if a 10,000-share order is executed in 50 prints (200 shares minimum size), then information leakage occurs 50 times in that pool vs. only one leak if all 10,000 shares are executed in one print.

#4 Does the pool use liquidity partners? If so, do they receive IOIs?

As we discussed previously, liquidity partners can help dark pools increase their trading volume but can also introduce information asymmetry. So traders should ask which liquidity partners the dark pool uses and if IOIs are sent from the dark pool to attract liquidity partner flow.

#5 For internalization pools, what kind of access does the prop desk have?

As discussed earlier, if the broker-dealer does not have Chinese walls between its dark pool and its prop desks, information asymmetry may occur. Similarly, if a black box is responsible for prop trading and it receives IOIs, information asymmetry can occur. Note that some internalization pools may allow you to opt out of prop flow interaction.

#6 What is the pricing structure?

“You get what you pay for” applies to dark pools very well. To play in a dark pool, streaming liquidity partners, smart routers, and market makers all require cheap pricing of liquidity. Moreover, the lower the commission charges, the cheaper “fishing” becomes. If the dark pool is priced at premium rates, only institutions with concerns about impact will play in the pool. To those institutions, the cost of premium rates at one or two cents per share is well worth avoiding the market impact they would sustain with large orders. To some extent, this results in the automatic “cleansing” of participants in dark pools

#7: What internal policing is in place?

Nobody does, or should, know more about the flow in a pool than the dark pool vendor itself. Going back to question #1, *constituent quality determines dark pool quality and policing tools can keep the pool clean*. While most dark pool operators claim that they have internal policing in place, the reality is that in today’s competitive market very few are interested in turning down customer flow. So, rather than simply asking the dark pool operator *if* the pool is policed, ask them *how* it is policed.

#8: How do dark aggregators or algorithms use exchange-based pools?

Exchange-based pools and even the non-exchange based pools with high concentration of smart router flow can support stock prices. Aggregators should not use exchange-based pools the same way they use other pools. For example, they should not park a large slice of orders in exchange-based pools. Ask if and how the broker algorithm differentiates these pools from others in order-handling rules.

#9 What is the average daily volume?

If a dark pool has very little or no volume it is more likely to use desperate measures to build liquidity which may lead to more information leakage. In addition, there is a high opportunity cost to sitting in a pool with little liquidity. The dynamics of each pool are different and require careful assessment. Given that, if you are using a dark pool aggregator, you should ask whether and how it accesses dark pools with very low average daily volume.

#10 How does the broker measure dark pool quality and what anti-gaming techniques are in place?

“What can be measured can be improved” applies to dark pools very well. Although it is important to understand the framework of information flow in dark pools, it is sometimes confusing and/or not even possible to get that information from the brokers. One way to overcome those limitations is by measuring each dark pool’s performance specifically in terms of impact, adverse selection and gaming. Second, the unique nature of each dark pool requires unique order handling techniques such as anti-gaming. Ask the broker for measurement reports and try to understand the anti-gaming techniques used within dark pool aggregators and algorithms.

Conclusion

Dark pools, in aggregate, only represent about 7% of the market’s entire volume.* They provide a unique opportunity for reducing impact and improving price yet they can be dangerous to those who do not understand them fully. “Fill rate” should not be the only criterion to evaluate a dark pool or a dark pool aggregator because fills may come at the expense of quality. Each dark pool is unique and customers need to understand the liquidity characteristics by demanding the utmost transparency from dark pool operators and dark pool aggregators alike. The framework provided in this article can help traders understand the implications of different liquidity characteristics. The largest implication, by far, is information leakage because it can lead to the negative consequences of price impact, gaming and adverse selection. A good understanding of this framework and the

“top questions to ask” can help customers use each dark pool properly rather than avoid them completely.

Lastly, customers should quantify or ask brokers providing dark aggregators to quantify the performance of each pool and the anti-gaming and sophisticated order placing techniques in place to avoid information leakage and some of its effects. We will discuss some of these quantitative techniques in our next article, tentatively titled “Quantifying Information Leakage and Anti-Gaming Techniques” in an upcoming publication of *Journal of Trading*.

*Trading Talk, “Let There Be Light,” Rosenblatt Securities, Inc., April, 2008.

A version of this article is forthcoming in Institutional Investor’s *The Journal of Trading*.